2015 Annual Report for California Melon Research Board

Project Title:

Melon weed management in California's desert growing region

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Project Objectives:

Our objectives were to evaluate the effect of pre emergence herbicides on cantaloupe safety and weed control in the Imperial Valley, providing region-specific treatment recommendations for melon growers in the Desert region. A secondary objective was to include treatments previously tested by Lynn Sosnoskie, Brad Hanson and Tom Lanini in Davis, laying the groundwork for a more comprehensive study to address the role of differences in climate, soils, and farming practices on herbicide efficacy.

Research Procedures:

The soil in the chosen field at the Desert Research Extension Center in Holtville, CA, was shaped into 80-inch “Yuma” beds in March 2015, subsurface drip installed for irrigation, and melon seeds (‘Navigator’ cantaloupe) planted into dry beds. The field was treated with glyphosate both before and after treatment application to kill any emerged weeds and start the experiment with a clean field (Figure 1).

The experiment was organized in a randomized complete block design with 5 replications and 11 treatments (2 rates of each of 5 herbicides: label rate and ½ label rate). The herbicides included Curbit, Dual Magnum, Prefar, Sandea, and Zeus, and an untreated control (Table 1). Each plot consisted of 3 beds each 30 feet long. All three beds in the plot received the same treatment, although measurements were taken only of the central bed, thus allowing the outer two beds to serve as guard rows. Untreated buffers of 10 feet separated each of the plots in the same bed.

To ensure accuracy of application rates, herbicides were applied on April 9 using a CO2-powered backpack sprayer calibrated to 20 gallons per acre carrier volume at a pressure of 20 psi with flat fan nozzles, using a 4-nozzle boom with 20 inch nozzle spacings (Figure 2). Following seedling emergence melons were thinned to a density of one melon plant per foot of row (which was equivalent to one melon per drip tape emitter; Figure 3). Following herbicide application, and melons were irrigated with subsurface drip to trigger germination and incorporate herbicides.

Weed cover and density and melon health, leaf and vine morphology, and flower and fruit counts were monitored every 2-3 weeks until weed densities became excessive in early June (Figure 4). At that time, plots were hand-weeded, and time to weed each plot was recorded (Figure5). Melon harvest began on June 29, and continued through July 24, with marketable and non-marketable melons being weighed and counted for each plot (Figure 6).

Results: Weed Control

The field site at the University of California Desert Research and Extension Center in Holtville, CA, was dominated by weed species such as amaranth (*Amaranthus palmeri*), lamb’s quarters (*Chenopodium album*), purslane (*Portulaca oleracea*), puncture-vine (*Tribulus terrestris*), jungle rice (*Echinochloa colona*), and sow thistle (*Sonchus oleraceus*). Early season (1 week after crop emergence) weed control was best for both rates of Curbit and Dual Magnum, and the high rate of Prefar (3.5-19.2 weed plants m^{-2}, Table 6). For specific species, both rates of Curbit and Dual Magnum provided better control of amaranth than the low rate of Prefar, either rate of Zeus, and the untreated control. Both rates of Curbit, Dual Magnum, and the high rates of Prefar and Sandea provided better control of lamb’s quarters than the untreated control, and also provided better control of purslane than the untreated control and both rates of Zeus. No differences among herbicides were observed in early season control of puncture vine and sow thistle. At 4 weeks after crop emergence, the high rate of Curbit and both rates of Dual Magnum provided superior weed control over the low rate of Prefar, both rates of Sandea, both rates of Zeus, and the untreated control (Table 7).

Plots were hand weeded in early June, following break of herbicide control. This occurred prior to measurements of later season weed control, which explains why weed densities are lower at 7 and 9 weeks after crop emergence. Hand weeding itself does provide useful data in the form of labor time or person-hours/minutes to weed the various treatments. Plots sprayed with the high rate of Dual Magnum required lower times to hand weed than the low rate of Sandea, both rates of Zeus, and the untreated control (Table 3). Later season weed control differences were less pronounced, with the high rate of Sandea having the highest weed densities 7 weeks after crop emergence (Table 8). Both rates of Dual Magnum and the high rate of Prefar provided best control of purslane, and worst control of sow thistle was seen in the high rate of Curbit. No other species-specific treatment differences were seen at 7 weeks after crop emergence. At 9 weeks after crop emergence, the high rate of Dual Magnum and Prefar were superior to the low rate of Prefar, with all other treatments and the untreated control being equal (Table 9). No species-specific differences were observed among treatments at 9 weeks after crop emergence.

Results: Crop Safety

At five weeks after crop emergence, the low rate of Prefar and the untreated control treatments had lower numbers of leaves per melon plant, smaller leaves, and lower numbers of flowers per plant (Table 4). Additionally, both rates of Zeus also had less leaves and less flowers per plant. No differences were observed in vine length or number of immature fruits per plant. At 8 weeks after crop emergence, the high rate of Dual Magnum had more leaves per plant than the low rate of Curbit, both rates of Prefar, the low rate of Sandea, both rates of Sandea, and the untreated control (Table 5). Both rates of Sandea had larger leaves than the low rate of Prefar and the untreated control. The high rate of Dual Magnum had longer vine lengths than the low rate of Prefar, both rates of Zeus, and the untreated control. The high rate of Dual Magnum had more flowers per plant than the low rate of Dual Magnum, both rates of Sandea, and the untreated control. The high rate of Dual Magnum also had more immature fruits per plant than the low rates of Prefar and Zeus.

Results: Crop Yield

No differences were observed among treatments for total number of fruits per plot (Table 2). The high rate of Sandea had a higher fruit weight per plot (143.3 lbs) than the low rate of Prefar (77.2 lbs), with all other treatments being equal. The high rate of Sandea had a larger fruit size (2.5 lbs) than the untreated control (2.0 lbs), with all other treatments being equal.

Conclusions and Future Research:

- The lowest levels of weed control occurred in the low rate of Prefar, both rates of Zeus, and the untreated control. The best weed control was achieved with Curbit and Dual Magnum.
- The smallest melon plants were found in the low rate of Prefar, both rates of Zeus, and the untreated control. It’s unclear if this was due to weed competition or from crop injury directly resulting from the herbicide treatments.
- Despite not being noticeably better than Curbit and Dual Magnum in weed control for most measurements, the high rate of Sandea had higher weight yield per plot and higher weight per plants, than the low rate of Prefar and the untreated control, respectively.
- A tremendous flush of weed emergence was observed in most plots at 4 weeks following crop emergence. Splitting herbicide applications between post-plant pre-emergence and

an additional application (same total rate of herbicide divided into two applications) may provide longer weed control, which would save money spent on labor for hand-weeding, as well as improve crop health and yields.

- Casual observations of Sudan grass planted after melon harvest indicated that residual effects of pre-emergence herbicides may be present longer than expected and could potentially be detrimental to crop rotations following melons.

Table 1: Treatments for weed management in cantaloupe at University of California Desert Research and Extension Center in Holtville, CA.

Herbicide Product	Active Ingredient	Product Rate (oz ac^{-1})*
Curbit EC	ethalfluralin	64
Curbit EC	ethalfluralin	32
Dual Magnum	metachlor	21.33
Dual Magnum	metachlor	10.67
Prefar 4E	bensulide	160
Prefar 4E	bensulide	80
Sandea	halosulfuron	0.750
Sandea	halosulfuron	0.375
Zeus	sulfentrazone	3.2
Zeus	sulfentrazone	1.6
Untreated	NA	NA

* Sandea rate is weight, all other rates are volume

Table 2: Mean total fruit number, weight (lbs), and mean weight per fruit (lbs) per plot. Non-marketable fruit excluded.

Treatment	Number (sum)	Weight (sum)	Weight/Fruit
Curbit @ 64 oz/ac	57.8 a*	139.6 ab	2.4 ab
Curbit @ 32 oz/ac	49.6 a	109.1 ab	2.2 ab
Dual @ 21.33 oz/ac	50.4 a	113.8 ab	2.3 ab
Dual @ 10.67 oz/ac	52.2 a	121.0 ab	2.3 ab
Prefar @ 160 oz/ac	53.2 a	116.4 ab	2.2 ab
Prefar @ 80 oz/ac	36.0 a	77.2 b	2.1 ab
Sandea @ 0.750 oz/ac	56.4 a	143.3 a	2.5 a
Sandea @ 0.375 oz/ac	42.2 a	100.5 ab	2.4 ab

Treatment	Number (sum)	Weight (sum)	Weight/Fruit
Zeus @ 3.2 oz/ac	50.4 a	108.0 ab	2.1 ab
Zeus @ 1.6 oz/ac	41.0 a	80.7 ab	2.0 ab
Untreated	47.8 a	96.1 ab	2.0 b

* Tukey's HSD used to calculate means separations. Values within a column with same letters are not different ($P \leq 0.05$).

Table 3: Total labor (minutes) per plot to hand hoe weeds following break of herbicide control at 6 weeks after crop emergence.

Treatment	Minutes
Curbit @ 64 oz/ac	66.6 bc*-
Curbit @ 32 oz/ac	69.6 bc
Dual @ 21.33 oz/ac	48.0 c
Dual @ 10.67 oz/ac	68.4 bc
Prefar @ 160 oz/ac	87.0 bc
Prefar @ 80 oz/ac	89.4 abc
Sandea @ 0.750 oz/ac	96.6 abc
Sandea @ 0.375 oz/ac	159.0 a
Zeus @ 3.2 oz/ac	121.8 ab
Zeus @ 1.6 oz/ac	129.0 ab
Untreated	125.4 ab

* Tukey's HSD used to calculate means separations. Values within a column with same letters are not different ($P \leq 0.05$).

Table 4: Mean number of leaves per plant, width of largest leaf (cm), length of longest runner (cm), number of flowers/plant, and number of immature fruits/plant at 5 weeks after crop emergence.

Treatment	Leaves/ Plant	Leaf Width	Vine Length	Flowers/ Plant	Fruits/ Plant
Curbit @ 64 oz/ac	31.0 a*	11.4 ab	27.7 a	11.1 a	2.4 a
Curbit @ 32 oz/ac	19.0 abcd	10.4 abc	42.6 a	5.7 abc	1.5 a
Dual @ 21.33 oz/ac	28.3 ab	10.4 abc	41.5 a	8.5 abc	2.2 a
Dual @ 10.67 oz/ac	29.1 ab	10.7 abc	19.5 a	10.0 ab	1.9 a
Prefar @ 160 oz/ac	20.8 abcd	10.4 abc	43.4 a	6.5 abc	1.4 a

Treatment	Leaves/ Plant	Leaf Width	Vine Length	Flowers/ Plant	Fruits/ Plant
Prefar @ 80 oz/ac	7.0 d	7.2 c	18.6 a	3.1 c	0.9 a
Sandea @ 0.750 oz/ac	26.7 abc	12.3 a	30.2 a	8.8 abc	1.2 a
Sandea @ 0.375 oz/ac	23.1 abcd	11.8 a	25.1 a	7.8 abc	2.1 a
Zeus @ 3.2 oz/ac	10.6 bcd	9.7 abc	37.7 a	3.4 c	1.0 a
Zeus @ 1.6 oz/ac	10.3 bcd	9.0 abc	29.4 a	3.9 cd	1.4 a
Untreated	8.0 cd	8.1 bc	26.3 a	2.5 c	1.1 a

[*] Tukey's HSD used to calculate means separations. Values within a column with same letters are not different (P ≤ 0.05).

Table 5: Mean number of leaves per plant, width of largest leaf (cm), length of longest runner (cm), number of flowers/plant, and number of immature fruits/plant at 8 weeks after crop emergence.

Treatment	Leaves/ Plant	Leaf Width	Vine Length	Flowers/ Plant	Fruits/ Plant
Curbit @ 64 oz/ac	41.4 abc[*]	11.7 abc	129.1 ab	3.3 ab	0.8 abc
Curbit @ 32 oz/ac	32.3 bcd	10.4 abc	96.6 abcd	3.7 ab	0.7 abc
Dual @ 21.33 oz/ac	58.8 a	12.1 ab	148.6 a	7.8 a	1.2 a
Dual @ 10.67 oz/ac	39.5 abc	11.5 abc	119.9 abc	2.3 b	0.7 abc
Prefar @ 160 oz/ac	35.6 bcd	10.9 abc	106.3 abcd	3.6 ab	0.6 abc
Prefar @ 80 oz/ac	21.6 cd	7.9 c	45.6 d	3.8 ab	0.1 c
Sandea @ 0.750 oz/ac	41.9 ab	13.2 a	149.2 a	1.6 b	1.0 ab
Sandea @ 0.375 oz/ac	38.1 bcd	13.2 a	139.3 ab	2.0 b	1.0 ab
Zeus @ 3.2 oz/ac	27.9 bcd	10.7 abc	73.9 bcd	4.4 ab	0.4 ab
Zeus @ 1.6 oz/ac	20.0 cd	9.9 abc	55.4 cd	3.8 ab	0.4 bc
Untreated	18.0 d	8.5 bc	46.0 d	2.4 b	0.4 abc

[*] Tukey's HSD used to calculate means separations. Values within a column with same letters are not different (P ≤ 0.05).

Table 6: Weed density by species (#/m^2) and total density at 1 week after crop emergence.

Treatment	Mean #/m^2							
	Amaranth	Lambs Quarters	Purslane	Puncture Vine	Jungle Rice	Sow Thistle	Other	Total Density
Curbit @ 64 oz/ac	0.3 c[*]	0.1 b	1.3 d	2.6 a	0.5 bc	0.0 a	6.4 ef	10.5 d
Curbit @ 32 oz/ac	1.6 c	0.5 b	0.3 d	3.5 a	0.0 c	0.0 a	11.2 ef	17.1 d

Treatment	Mean #/m^2							
	Amaranth	Lambs Quarters	Purslane	Puncture Vine	Jungle Rice	Sow Thistle	Other	Total Density
Dual @ 21.33 oz/ac	0.0 c	0.0 b	0.0 d	1.6 a	0.3 bc	0.0 a	1.6 f	3.5 d
Dual @ 10.67 oz/ac	0.0 c	1.3 b	1.3 d	2.1 a	0.3 bc	0.0 a	6.1 ef	11.2 d
Prefar @ 160 oz/ac	5.3 bc	1.6 b	0.8 d	2.9 a	0.8 bc	0.0 a	7.7 ef	19.2 d
Prefar @ 80 oz/ac	19.5 ab	12.5 ab	17.3 bcd	3.7 a	9.3 abc	0.0 a	15.5 def	77.9 c
Sandea @ 0.750 oz/ac	8.0 bc	2.1 b	3.7 d	0.5 a	2.1 bc	0.0 a	82.9 b	99.5 bc
Sandea @ 0.375 oz/ac	9.6 bc	5.6 b	5.3 cd	1.6 a	4.0 bc	0.0 a	140.0 a	166.1 a
Zeus @ 3.2 oz/ac	28.0 a	10.4 ab	29.9 bc	3.2 a	10.7 ab	0.5 a	53.1 bcd	135.7 ab
Zeus @ 1.6 oz/ac	29.3 a	8.3 ab	38.7 a	4.3 a	17.6 a	0.5 a	54.4 bc	153.1 ab
Untreated	32.5 a	23.2 a	56.0 a	2.1 a	6.9 bc	0.0 a	44.0 cde	164.8 a

[*] Tukey's HSD used to calculate means separations. Values within a column with same letters are not different ($P \leq 0.05$).

Table 7: Mean number of leaves per melon plant, diameter of widest leaf, and total weed cover at 4 weeks after crop emergence.

Treatment	Leaves/Plant	Leaf Width	Weed Cover
Curbit @ 64 oz/ac	23.2 a[*]	54.4 a	30.5 cd
Curbit @ 32 oz/ac	12.9 bcd	36.1 bc	53.3 bc
Dual @ 21.33 oz/ac	16.5 ab	36.3 bc	17.4 d
Dual @ 10.67 oz/ac	18.4 ab	49.6 ab	34.8 cd
Prefar @ 160 oz/ac	12.0 bcd	34.5 bcd	51.0 bc
Prefar @ 80 oz/ac	6.5 d	19.3 d	83.0 a
Sandea @ 0.750 oz/ac	17.8 ab	50.8 ab	74.0 ab
Sandea @ 0.375 oz/ac	14.2 bc	48.3 ab	91.2 a
Zeus @ 3.2 oz/ac	8.4 cd	29.3 cd	91.0 a
Zeus @ 1.6 oz/ac	7.5 cd	28.5 cd	96.3 a
Untreated	6.5 d	25.1 cd	94.3 a

[*] Tukey's HSD used to calculate means separations. Values within a column with same letters are not different ($P \leq 0.05$).

Table 8: Weed density by species (#/m^2) and total density at 7 weeks after crop emergence.

Treatment	Mean #/m^2							
	Amaranth	Lambs Quarters	Purslane	Puncture Vine	Jungle Rice	Sow Thistle	Other	Total Density
Curbit @ 64 oz/ac	0.0 a*	0.3 a	0.4 bc	0.3 a	0.2 a	0.7 a	0.3 b	2.2 b
Curbit @ 32 oz/ac	0.0 a	0.0 a	3.2 ab	0.3 a	1.3 a	0.3 ab	0.3 b	5.3 b
Dual @ 21.33 oz/ac	0.0 a	0.5 a	0.0 c	0.3 a	0.8 a	0.0 b	0.3 b	1.9 b
Dual @ 10.67 oz/ac	0.0 a	0.3 a	0.3 c	0.0 a	0.3 a	0.0 b	0.3 b	1.1 b
Prefar @ 160 oz/ac	0.0 a	0.3 a	0.3 c	0.0 a	0.5 a	0.0 b	0.3 b	1.9 b
Prefar @ 80 oz/ac	0.3 a	0.8 a	1.1 bc	0.0 a	1.6 a	0.0 b	0.8 b	4.0 b
Sandea @ 0.750 oz/ac	0.0 a	1.1 a	4.3 a	0.3 a	0.8 a	0.0 b	4.0 a	10.4 a
Sandea @ 0.375 oz/ac	0.0 a	0.3 a	3.2 ab	0.0 a	0.5 a	0.0 b	0.8 b	4.8 b
Zeus @ 3.2 oz/ac	0.0 a	0.0 a	1.3 bc	0.0 a	0.3 a	0.0 b	0.3 b	1.6 b
Zeus @ 1.6 oz/ac	0.0 a	0.0 a	0.5 bc	0.3 a	1.3 a	0.0 b	0.0 b	2.7 b
Untreated	0.0 a	0.0 a	1.1 bc	0.3 a	0.0 a	0.0 b	0.8 a	2.1 b

* Tukey's HSD used to calculate means separations. Values within a column with same letters are not different ($P \leq 0.05$).

Table 9: Weed density by species (#/m^2) and total density at 9 weeks after crop emergence.

Treatment	Mean #/m^2							
	Amaranth	Lambs Quarters	Purslane	Puncture Vine	Jungle Rice	Sow Thistle	Other	Total Density
Curbit @ 64 oz/ac	0.0 a*	0.2 a	2.4 a	0.2 a	1.6 a	0.3 a	0.5 b	5.0 ab
Curbit @ 32 oz/ac	0.0 a	0.3 a	3.7 a	0.5 a	2.1 a	0.0 a	0.8 ab	7.5 ab
Dual @ 21.33 oz/ac	0.0 a	1.1 a	0.5 a	0.0 a	1.9 a	0.0 a	1.3 ab	4.8 b
Dual @ 10.67 oz/ac	0.0 a	0.8 a	2.7 a	0.0 a	2.4 a	0.0 a	0.3 b	6.1 ab
Prefar @ 160 oz/ac	0.0 a	0.0 a	0.3 a	0.0 a	0.8 a	0.0 a	0.5 b	1.6 b
Prefar @ 80 oz/ac	0.0 a	0.0 a	12.3 a	0.5 a	4.0 a	0.0 a	2.1 ab	18.9 a
Sandea @ 0.750 oz/ac	0.0 a	0.3 a	9.3 a	0.3 a	0.5 a	0.0 a	4.0 a	14.4 ab
Sandea @ 0.375 oz/ac	0.0 a	0.3 a	6.9 a	0.0 a	1.6 a	0.0 a	2.7 ab	11.5 ab
Zeus @ 3.2 oz/ac	0.0 a	0.0 a	10.1 a	0.5 a	0.8 a	0.0 a	0.0 b	11.5 ab
Zeus @ 1.6 oz/ac	0.0 a	0.0 a	5.3 a	0.0 a	3.2 a	0.0 a	0.5 b	9.1 ab
Untreated	0.0 a	0.1 a	3.2 a	0.1 a	1.6 a	0.0 a	0.9 ab	5.9 ab

* Tukey's HSD used to calculate means separations. Values within a column with same letters are not different ($P \leq 0.05$).

Figure 1: Clean field with shaped beds and post plant/pre emergence herbicide application.

Figure 2: Detail of herbicide application showing CO_2 backpack sprayer with 4-nozzle boom.

Figure 3: Melons thinned to one plant per foot of row (= one plant per emitter).

Figure 4: Excessive weed growth in early June, signally end of herbicide residual effects.

Figure 5: Hand-weeding of melon plots following loss of herbicide control. Time to weed each plot was recorded.

Figure 6: Lack of uniformity in melon size, including non-marketable melons, dictating that harvest take place over an extended time.